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An Introduction To

Handling Liquid Manure

AGRICULTURAL ENGINEERS' DIGEST

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INTRODUCTION

Livestock manure must be disposed of in such a way that the health, safety, and sanitation of people and animals is maintained. The water supplies for people and animals must not be contaminated with manure or the seepage from manure. Odors, flies, and other nuisances should be prevented from developing within the manure.

One way of accomplishing these objectives, and at the same time dispose of manure in a reasonably efficient manner, is by handling manure as a liquid rather than a solid or semi-solid. Liquid manure is a mixture of solid and liquid excrements, and enough water to make the mixture a liquid. It is usually best to keep other solid material out of the mixture.

Advantages

Many livestock producers are handling manure as a liquid for one or more of the following reasons:

1. The manure contains more nutritive and organic value than can be saved by storing the wastes as solids or semi-solids.

Fertilizer Value of Liquid Manure

Animal	Lbs. of Nutrients Per Ton of Manure		
	Nitrogen	Phosphorus	Potassium
Dairy Cattle	11	2	10
Cattle	14	4	9
Swine	10	3	8
Horses	14	2	12
Sheep	28	4	20
Poultry	31	8	7

2. Some labor required for removing and disposing of solid manure can be eliminated. Most producers who handle manure as a liquid have their facilities designed so the manure falls through holes in the floor, or is scraped into an underground holding tank; the manure does not have to be lifted onto a pile or spreader.
3. The disposal of the liquid can be infrequent and can fit into field schedules, soil conditions, etc.
4. The manure is stored submerged in water, so objectionable odors, unsightliness, and fly problems can be controlled and sometimes eliminated. The odors that occur when manure is spread on a field are intermittent instead of daily.

5. It is sometimes convenient for a group of neighbors to cooperatively purchase and use the more expensive hauling and disposal equipment.

Facilities and Equipment

Handling livestock wastes as liquid requires some special equipment and facilities. These include:

1. A water-tight storage container to which water can be added.
2. The equipment or designed facility to get the solid and liquid excrements into the storage; i.e. scraper, gutters, slotted floors, drains, etc.
3. Equipment that will stir the manure, and equipment that will remove the liquid from the storage; i.e. pumps, agitators, augers, etc.
4. Equipment or facilities that will dispose of the liquid manure; i.e. tank truck or wagon, irrigation fields, available land, a lagoon, etc.

THE STORAGE

The storage may be a separate tank or it may be part of the livestock facility (i.e. a pit under slotted floors). Dairy sanitarians may not allow the storage to be under a slotted floor where cows are milked. A dairyman should consult milk inspection authorities before constructing any manure handling system.

The storage area should be located at least 100 feet from any water supply. Do not construct the storage over creviced bed-rock or other sub-soil condition where uneven settling could cause the storage container to break and leak.

Size

The size of the container will depend on the way a livestock operation is managed, the length of time between emptyings, and the kind, number, and size of the animals. Large storages have maximum labor advantage.

Extension Service

University of Nebraska College of Agriculture and Home Economics
and U. S. Department of Agriculture Cooperating
E. F. Frolik, Dean J. L. Adams, Director

APPROXIMATE DAILY MANURE PRODUCTION

Animal	Cu. Ft./Day Solids & Liq.	Percent Water	Gallons/ Day
1000 lb. cow	1 1/2	80-90	11
1000 lb. steer	1	80-90	7 1/2
1000 lb. horse	3/4	65	5 1/2
10 head of hogs			
50 lbs.	2/3	75	5
100 lbs.	1 1/3	75	10
150 lbs.	2 1/4	75	17
200 lbs.	2 3/4	75	20 1/2
250 lbs.	3 1/2	75	26
10 head of sheep	1/2	70	4
1000 5-lb. layers	3.	55-75	22 1/2

There are about 34 cu. ft. in a ton of manure.

Cattle may deposit half their excrement in an outside feeding and lounging yard, and therefore, the liquid excrement may be lost.

Cleaning swine facilities with high-pressure water may double the volume of wastes.

Roof or lot drainage that is allowed to go into the storage, will have an unpredictable effect.

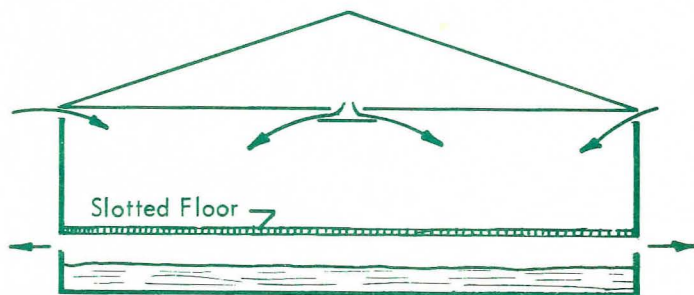
Extra water must often be added to liquify the wastes. From 1/5 to 3/5 of the storage volume may be needed for extra water if the manure is to be pumped. For irrigation, there should be about 95 percent water and 5 percent manure. Keep extra water to a minimum if the manure is to be field spread.

Storage Capacity = no. of animals x daily manure production x desired storage time (days) + extra water.

Storage tank dimensions and proportions should follow the recommendations of the agitator manufacturer. See agitators, page 3.

Ventilation

Indoor tanks should be positively ventilated. Locate fans to draw air from the building and across the manure, and to exhaust directly outdoors.



Construction

All storages must be water-tight. Insulate storage tanks against freezing. When construction is completed, clean out chips, nails, lumber, etc.

LOADING THE STORAGE

Add water to the storage container before filling it with manure. Add 3 to 4 inches under slotted floors, and add 6 to 12 inches when the storage will be loaded with batches of scraped wastes.

Keep all tank openings closed when not in use, and maintain a program of fly control, including bait and spray insecticide and repellants. Fly reproduction can be discouraged by keeping all solids submerged.

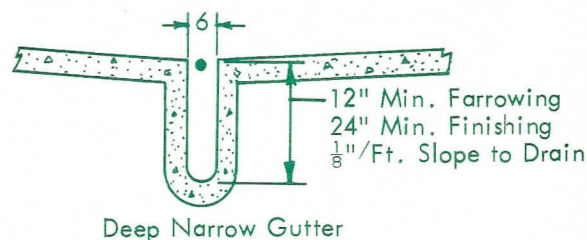
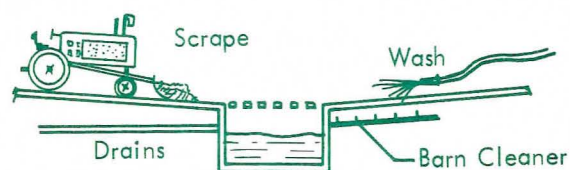
Never add frozen manure to a storage tank.

Scraping, Washing

Wastes should usually be scraped into a gutter or storage frequently to keep them wet. Wastes are sometimes hard to reliquify.

For washing, 100 to 150 pounds of pressure is usually needed to do a good job. Consider draining off some of the stored liquid to a lagoon. The solids and semi-solids left would have less nutritive value, but the time interval between emptying could be longer.

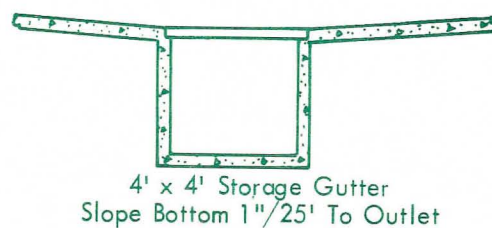
Examples: Beef feedlot scraped to underground storage; Dairy barn with barn cleaner; Dairy and beef confinement buildings with underfloor storage; Poultry cage buildings with shallow manure trenches. Swine buildings with storage gutters; livestock buildings designed with drain lines running to a storage.



Slotted Floors

The slots must be large enough to allow the solids to be worked through. Some scraping or washing may be necessary if the entire floor is not slotted.

Examples: Swine, cattle, and poultry confinement buildings.

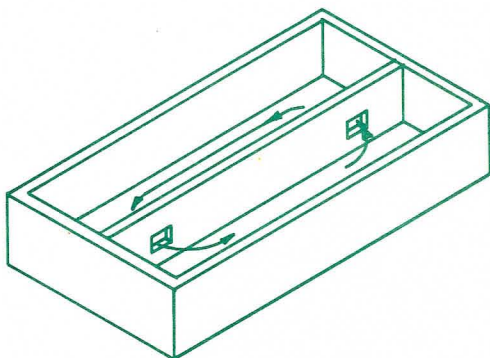


EMPTYING THE STORAGE

Some solid excrements, especially from swine, settle to the bottom of the storage. Cattle wastes form a scum layer, and some manure floats. To liquify all the wastes, it is usually necessary to agitate the storage contents prior to emptying. Agitation is usually not needed for long storage gutters that are emptied by removing a plug at one end.

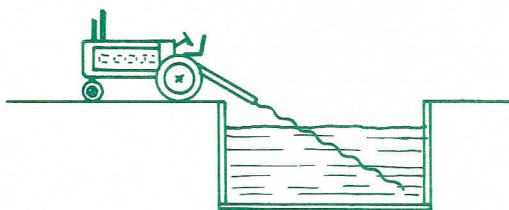
Agitators

For large tanks, most effective agitation is usually obtained with recirculating pumps operating at about 2000 gallons per minute.



To help the manure circulate during agitation, connect long storage gutters, or divide under-floor storages.

Paddle agitators are usually effective only in smaller tanks. Augers are sometimes used, but are usually not too effective.



12"-14" Auger Agitator

Pumps

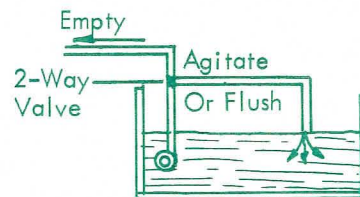
Many types and sizes of pumps are available to remove the liquid manure. Some common types are listed below:

Pump on a wagon -- Creates a vacuum within the wagon which sucks the liquid from the storage; creates pressure within the wagon for unloading. Small storages can sometimes be agitated satisfactorily by partially filling the wagon, then reversing the pump and emptying the wagon back into the storage. A PTO unit pumps about 300 gallons per minute.

Centrifugal pump without choppers -- is submerged in the manure and can pump into a tank wagon. Pump sizes range from $1\frac{1}{2}$ to 5 horsepower. They deliver up to 2000 gallons per minute. Solids and bedding may clog centrifugal pumps.

Diaphragm pumps -- a 3 inch, 2 horsepower pump will lift 50 to 70 gallons per minute, and can handle some solids.

Chopper-impeller pumps -- are designed to pump manure that contains chopped hay, feathers, etc. Typical sizes range from 5 to 30 horsepower. They deliver from 300 to 2500 gallons per minute.



UNLOADING PUMP with by-pass to agitate storage or flush long gutters.

Augers

Augers are not very efficient for moving liquid manure. Augers are commonly powered with PTO driven hydraulic motors. One to 5 horsepower will lift 40 to 180 gallons per minute through 4 to 6 inch augers.

DISPOSAL

Liquid manure can be disposed of through irrigation lines, with spreading equipment, or by decomposition in a lagoon.

Irrigation

The liquid manure should be about 95 percent water and thoroughly agitated for irrigation. Contact your County Extension Director or consult one of your state's agricultural engineers.

Field-spreading

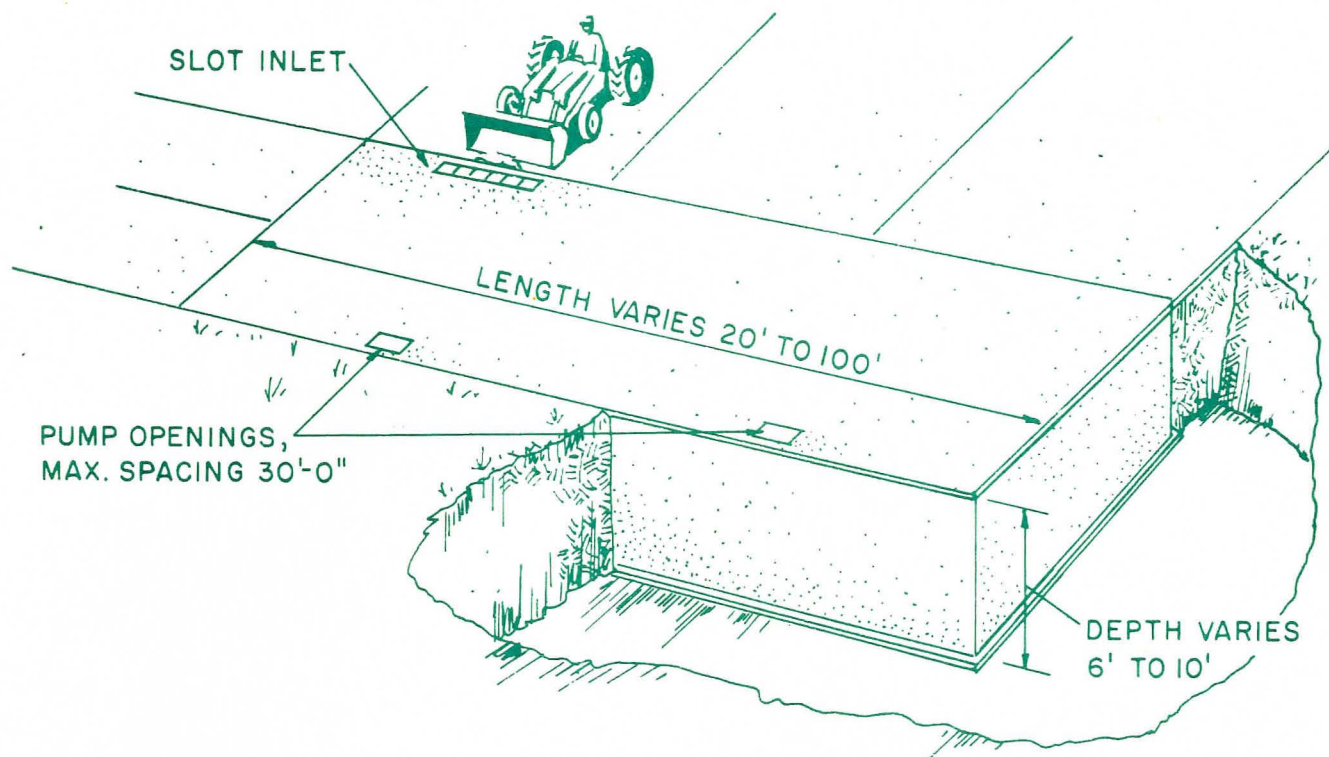
Keep extra water to a minimum if the manure will be spread with a tank wagon. Wagon tanks are available in sizes of 750 to 2500 gallons. The tires for the wagon should be of wide floatation construction to minimize damage to a field. An agitator in the tank improves uniform delivery and reduces plugging.

Gravity or pumped delivery is acceptable as even distribution of the manure is usually not required.

Lagoons

Some livestock producers are draining or pumping any extra storage water and some of the liquid excrements to a lagoon. The solids and semi-solids left in storage are then spread on a field when convenient. A lagoon does not have to be as large when the solids will not be decomposed. Some of the nutritive value for the field-spread manure will be lost.

Livestock manure is sometimes placed in a large lagoon that will decompose all the wastes. All nutritive value is lost. Storage tanks are usually not needed or desirable with this disposal method. See AED-1, "Lagoon Manure Disposal," at your County Extension Office.



USDA MANURE TANK PLANS

Three plans for reinforced concrete tanks with floor level reinforced concrete lids.

5981, Rectangular, 6' to 10' deep, 20' wide, any length.

5984, Circular, 6' to 10' deep, 32' or 48' diameter.

5987, Rectangular, 10' deep, 12' to 24' wide, any length.

Obtain plans through your county extension office or from Extension Agricultural Engineering at your state university.